

Detention Basin Inspection and Maintenance Guidelines

**TOWNSHIP OF BETHLEHEM
HUNTERDON COUNTY, NEW JERSEY**

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Purpose

This manual is intended to be a practical tool to aid in the inspection and maintenance of stormwater management facilities within a development. Due to the number of developments within Bethlehem Township, site specific guidelines are not feasible. Homeowner Associations or individuals responsible for maintaining stormwater management facilities may need to engage the services of a licensed professional engineer for additional site specific guidance. This manual has been prepared to address the types of stormwater management basins existing in Bethlehem Township at the time of its writing.

Stormwater Runoff Control

During precipitation or snow melt, portions of the water soak into the ground, evaporate or flow over land. The part that flows over land is called stormwater runoff. In natural settings, water from storm events is slowed by vegetation and other obstacles as it flows over land. Depending on soil types, most of the stormwater infiltrates into the soil.

In developed areas, much of the land is covered by hard surfaces such as buildings and pavement. These hard surfaces, due to their impervious nature, allow little to no infiltration. This results in an increase in the stormwater runoff quantity and the ability for the runoff to convey various pollutants to the natural waterways. Pollutants may include oil, antifreeze, salt, cigarette butts, paper and other trash. Soil and organic material can also be transported as the runoff flows from hard surfaces and erodes less stable surfaces.

Residential and commercial developments within Bethlehem Township were required by State, County and Municipal regulations to attenuate the additional runoff such that the post-developed runoff rates to adjacent properties and waterways did not exceed the pre-developed condition. Over time the regulations evolved to require specific reductions in runoff from various storm events. For example, the 100 year storm event needed to be reduced to 80% of the pre-developed condition.

To address the regulations, developments incorporated detention basins in their design. These basins, with a system of control devices are generally designed to slow down or hold the water for a short time and remove pollutants before it is released to a stream. Stormwater controls are widely referred to as best management practices or BMPs. All of the residential developments within Bethlehem Township for which this manual is applicable have generally the same features.

Inspection

Stormwater controls must be routinely inspected and maintained to ensure they continually function as designed. If proper maintenance is not provided, adverse environmental impacts such as the discharge of pollutants into ground and surface waters may occur. In extreme cases, the structural integrity of the detention basin berm or control structures can be compromised resulting in failure and flooding of downstream areas.

Stormwater management facilities must be routinely inspected and have the necessary maintenance performed on them to be certain that they continually function as designed. An inspection checklist is provided in Appendix "A" of this report. The following is a list of problems that may be encountered during an inspection.

General Site Conditions

- Trash and debris
- Evidence that water remains in the basin longer than 5 days. Cattails and other wetland vegetation are good indicators that water is remaining in the basin longer than intended. If this is the case, try to determine the cause of the standing water.
- Animal burrows
- Vandalism

Structural/Mechanical

- Obstructions of the inlet or outlet devices by trash, debris, and vegetative growth
- Cracks and deterioration of inlets, outlet structures, pipes, and catch basins
- Damaged or missing trash racks
- Outlet protection buried with silt and sediment
- Damaged or sediment laden low flow channels
- Water seepage or ponding

Vegetation

- Bare ground void of vegetation
- Weeds and woody vegetation
- Invasive plant species
- Trees and other woody vegetation on the berm

Earthwork

- Excessive erosion or sedimentation, particularly in emergency spillways and swales.
- Cracks or settling in the embankment or berms
- Deterioration of downstream channels

Frequency of Inspection

Regularly conducted inspections are crucial to ensure effective performance. Inspection frequency varies based on the stormwater management feature. As a guideline, the following should be followed at a minimum. Significant storm events may necessitate more frequent inspections.

- General Site Conditions - Monthly
- Structural/Mechanical Components – Annually
- Earthwork - Annually
- Vegetation – Biannually
- Trash Racks and Grates – After every major storm event for clogging.

Safety Considerations

Safety considerations must be a constant focus during stormwater control inspections. Prior to conducting the inspection, anticipate any potential hazards based on recent or current conditions (i.e., flooding after a heavy rain). Always avoid hazardous conditions and document them on the inspection checklist.

Common safety concerns when performing stormwater control inspections include:

- Never conduct inspections of confined spaces alone, without proper training.
- Take precautions around standing water; depths are likely unknown and the ground may be unstable.
- Park in areas that provide safe entrance and exit of work area; do not create potential conflicts with other vehicles/equipment operating in the work area; and provide maximum protection for workers entering and exiting the vehicle along roadways.
- Always wear protective clothing, boots, and safety vests.
- Be cognizant of the hunting seasons.
- Be aware of large vertical drops and avoid standing on retaining walls or other structures that present a fall hazard. Make a note of hazard areas on the inspection form.
- If toxic, hazardous or unknown substances are discovered in the area, leave the vicinity and report the findings by contacting 911.
- Be aware of loose material (such as riprap), excavation drop-off, tripping hazards, uneven ground, and other obstructions.
- Be aware of poisonous plants, insects, and wildlife.

Reporting and Record Keeping

Observations made at the time of inspection pertaining to the status of the stormwater control shall be documented. All inspection findings and maintenance activities should be noted on the appropriate inspection form in Appendix A. Completed inspection forms are to be retained by the entity responsible for maintaining the stormwater management system with copies provided to the Bethlehem Township Clerk and an annual basis.

Overall Maintenance

Stormwater management controls require two basic types of maintenance: (1) routine maintenance and (2) emergency maintenance. All routine maintenance and/or emergency repair needs found at the time of inspection should be identified and reported. Visual observations, contacts made, maintenance performed, and any maintenance recommended at the time of inspection must be documented.

If emergency maintenance needs are found, the inspector should either take immediate action to correct the problem(s) or alert the responsible parties of maintenance and/or repair needs. A follow-up inspection should be made to ensure that corrective actions have been satisfactorily completed and normal operation has been restored. All correspondence and corrective actions shall be documented.

Routine Maintenance

Routine maintenance is any procedure performed on a regular basis to maintain the proper working order of a stormwater control. Tasks associated with routine maintenance include, but are not limited to, the following:

- Periodic maintenance of grasses, trees, shrubs, and other desirable plant species
- Removal of undesirable plant species
- Removal of trash and debris
- Upkeep of mechanical/structural components

Routine maintenance predominately involves some type of vegetation management practice. Care should be taken to avoid using equipment that can cause soil compaction in or around stormwater controls. Heavy equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high-pressure tires can cause excessive compaction resulting in reduced infiltration and damage to underdrain systems. When mowing in or around a stormwater control, use riding mowers or tractor mowers with turf-type tires, push mowers and/or weed eaters.

Emergency Maintenance

Emergency maintenance is a non-routine repair performed to correct a problem and restore a stormwater control to its proper working order. Tasks associated with emergency maintenance include, but are not limited to:

- Sediment removal
- Structural repair
- Erosion repair/bank stabilization

Since emergency maintenance needs (i.e., berm failure) often require both structural repair and soil stabilization work, it is anticipated that most emergency repairs will be performed under the guidance of a licensed professional engineer. If emergency maintenance needs are found, the inspector should either take immediate action to correct the problem(s) or alert the responsible parties of maintenance and/or repair needs.

Vegetative Maintenance

Desirable vegetation is an important component of many stormwater controls. Basins currently within Bethlehem Township are designed to be stabilized with turf-type grasses along the bottom, side slopes and berms. The grass is to help control erosion, provide structural stability and remove pollutants from stormwater runoff. Some have native/ornamental grasses, trees, shrubs, and herbaceous plants around their outside perimeter. Desirable vegetation can also enhance the aesthetic appeal of stormwater controls and enable them to blend into the landscape.

Periodic maintenance of desirable vegetation is required to ensure that it remains healthy and established. Climatic conditions, lack of proper maintenance, storm events, vehicular/equipment traffic, and vandalism can have a detrimental effect on plant material. Provisions may be needed to supplement or replant some vegetated areas due to plant loss. Supplemental and replacement planting should occur during the appropriate planting season for the particular plant species being utilized. These new plantings will require additional care until they are established.

Turf-Type Grasses

Turf-type grasses are common to most stormwater controls. They can be the major component in a stormwater control's makeup or simply used to stabilize the areas surrounding a stormwater control. Turf-type grasses provide soil stability, reduce water flow velocities, and help maintain the structural integrity of stormwater controls. They serve as pretreatment for stormwater controls by slowing the overland runoff and filtering out sediment and pollutants. If maintained properly, turf-type grasses can also improve access to stormwater controls, making inspection and maintenance tasks easier.

Provisions should be made to reestablish a uniform cover of turf-type grass on those areas damaged by sediment accumulation, stormwater flow, and/or vehicular/equipment traffic. Failure to maintain a uniform turf-grass cover could result in structural failure and sediment loss. Any turf found not in a healthy growing state should be evaluated to determine the maintenance needs (i.e., fertilization, repair seeding, sodding).

Mowing should be tailored to the specific site conditions, turf-grass type, and seasonal variations. Ideally, turf-type grasses should be mowed at a frequency to maintain a maximum height of 4 inches for warm-season grasses and 6 inches for cool-season grasses. Mowing activities should include trimming grass around fences and structures. All clippings discharged from mowers or string trimmers should be directed away from the stormwater device so they do not add nutrients to the water.

Herbaceous Plants and Native/Ornamental Grasses

Existing stormwater management basins within Bethlehem Township are not designed to have herbaceous plants or native ornamental grasses within the storage area of the basin or on its berms. Current regulations permit basins to be designed with herbaceous and native/ornamental grasses to provide additional water quality treatment and reduce routine maintenance. However the basins within Bethlehem Township predate these regulations and would require a retrofit design prepared by a licensed professional engineer. (See Appendix “B” for Rutgers Cooperative Extension document on Detention Basin Refits and Maintenance.) Therefore basin maintenance will require the removal and replacement of these plants with turf type grasses.

Trees and Shrubs

Existing stormwater management basins within Bethlehem Township are not designed to have trees or shrubs within the storage area of the basin or on its berms. Current regulations permit basins to be designed within the bottom of the basin. However the basins within Bethlehem Township predate these regulations and would require a retrofit design prepared by a licensed professional engineer. Therefore basin maintenance will require the removal and replacement of trees and shrubs with turf type grasses. **In all cases berms should be kept free of trees, shrubs and woody plants. Root structures associated with these plants can compromise the stability and promote capillary movement of water through the berm.**

Fertilization

Fertilizer should only be used when necessary and not as a routine seasonal practice. Spread fertilizer uniformly over the targeted area; during application, use extreme care to prevent the fertilizer from contaminating the stormwater control or adjacent streams, ponds, lakes, or other bodies of water. Immediately incorporate fertilizers into the soil when seeding. Do not apply topdressing fertilizers to grass swales, filter strips, or buffer areas that drain to nutrient sensitive water bodies.

Undesirable Vegetation Removal

If proper maintenance is not provided, undesirable vegetation such as weeds, grasses, and woody plants (trees and shrubs) will invade the vegetated areas of stormwater controls. In time, this vegetation can inhibit the ability of a stormwater control to store, treat, and/or convey water. .

Invasive plant species should be eliminated within all areas of the basin. New Jersey invasive species can be readily identified on smartphones by downloading an APP from NJDEP at <http://www.njisst.org/NRCSSGrant.htm> or from lists provided at <http://www.invasivespeciesinfo.gov/unitedstates/nj.shtml#thr>.

Remove undesirable vegetation before it becomes established. Once established, this plant material can have an adverse effect on the survivability of desirable plants and the aesthetic appeal of stormwater controls. The best time to do this is during routine mowing or plant maintenance activities. Undesirable plants can be removed by physical, mechanical, and/or herbicidal practices. Dispose of the trimmed plant material properly; do not discard into waterways because the material could clog the waterways and add nutrients to the water or reestablish elsewhere.

Undesirable Woody Vegetation Removal

Although plant roots are important for soil stabilization, they can present problems if volunteer trees and shrubs are allowed to mature in locations they are not wanted. Mature trees and shrubs can impede and redirect water flow in inlet and outlet ditches. As trees and shrubs mature, their root systems can penetrate deep into the basin and clog the underdrain system. Decaying plant roots can create voids in the dams and embankments when mature trees die or are cut. This can result in structural failure if the situation is not addressed. Woody vegetation not removed can also impede access to basin control structures.

Remove undesirable woody vegetation when found and dispose of it off-site. Any void created by removal activities should be completely filled in and properly compacted using an appropriate earthen material. Reestablish desirable vegetation to stabilize the area and prevent erosion.

Trash and Debris Removal

Trash and other debris can pollute surface waters and damage stormwater control devices. The removal of floating trash and other debris will not only improve water quality, it will reduce the potential for outlet clogging during storm events and improve the overall aesthetic appeal of a stormwater management basin. Trash should be removed on a routine basis as part of the maintenance activities. Remove trash and debris from outlet orifices, trash racks, basin and swale floors and side slopes, and other components, as well as from the area surrounding the basin.

Mechanical and Structural Component Maintenance

Mechanical/structural components need to be maintained regularly to ensure that they remain functional at all times. All mechanical components, including valves, sluice gates, pumps, fences, gates, trash racks, and access hatches, should be operated during each inspection to ensure that they function properly. Check security components such as fences, gates, and locks for soundness. Repair any fence, gate, or lock found damaged in a timely manner in order to restore site security and safety.

Mechanical/structural repairs should be made promptly by qualified personnel. Equipment, materials, and personnel should be readily available to perform repairs on short notice. The following conditions could lead to structure failure and may necessitate an emergency repair: a broken sluice gate; cracks in concrete outlet structures; settling, scouring, cracking, sloughing, or furrowing on embankments; or seepage around an outflow pipe.

Outlet Control Structure

The outlet control structure is used to drain the dry detention basin. Outlet control structures can have several components, including a trash rack, a trash screen, one or more drawdown orifices, and an outlet pipe. The drawdown orifice(s) is located at the bottom of the outlet control structure and slowly drains the basin, reducing peak flow and allowing solids to settle. Typically, the outlet control structure has a second, larger opening that allows flow from large rainfall events to escape without overtopping the basin. Usually, this is in the form of an open-top outlet structure. All outlet controls should have a trash rack installed at their inlet.

Standing water in the basin may conceal parts of the outlet structure. If access to submerged components is needed, the basin can be drained or pumped out; however, the water must first be visually inspected for obvious signs of pollutants. Check for an oily sheen or excessive suspended solids. If either of these is present, do not drain the basin and contact the appropriate authority for guidance.

Treated water should be allowed to flow freely upon entering the outlet control structure. Inspect the outlet control structure thoroughly for any signs of damage such as cracking, holes, or leakage. Verify that the outlet box remains covered with a trash rack. Repair any damaged areas of the outlet control structure, and remove sediment and debris if it is accessible. If the outlet is clogged or blocked and standing water prevents access to the structure, hip waders or a small boat may be needed to make the necessary repairs. Ensure that proper safety procedures are followed when working in or around standing water.

Trash Racks

Positioned atop the outlet control structure (box) and in front of any weir or orifice, the trash rack protects the flow through the outlet structure from becoming clogged with debris. Inspect the trash rack for debris and excessive corrosion. Remove trash and debris. Replace the trash rack if it is corroded or otherwise damaged. The replacement trash rack should be consistent with the original design specifications.

Outlet Drainage System

The outlet drainage system conveys water from the outlet control structure through the embankment to a swale or other open channel. Inspect the inside of the outlet box and pipe(s) for sediment and debris. Inspect the ground surface above buried pipes and structures for depressions or other signs that might indicate pipe breakage or separation. Inspect ditches for signs of erosion and undesirable vegetation.

Remove any sediment or debris that is accessible. Repair eroded areas and damaged pipes. Replace outlet protection materials (i.e., riprap) as necessary.

Emergency Spillway

The emergency spillway serves as an overflow structure that is typically constructed as a channel in natural ground. The emergency spillway is necessary to minimize the potential for overtopping the basin, which can damage the embankment and lead to failure and downstream flooding.

The emergency spillway should remain free of trash and debris. Emergency spillways are typically covered with grass, but concrete and riprap are also used. For grass channels, verify that grass is maintained as previously described. Inspect concrete to verify that it is in good condition, or verify that adequate riprap is present. Note all erosion and undesirable vegetation.

Emergency spillways must be free of trash, debris, and undesirable vegetation to maintain their functionality. Remove these if present. Grass should be carefully maintained as previously described. If applicable, repair concrete or replace riprap as necessary. Repair areas of erosion.

Sediment Removal

Sediment will eventually accumulate in every type of stormwater control. The degree to which it accumulates will depend on the upstream sediment source, rainfall intensity, and the amount of runoff that a basin receives. Any sediment found blocking the inlet or outlet of a stormwater control should be removed. If sediment buildups are allowed to block inlets or outlets, stormwater may be diverted to areas of the basin not designed for concentrated water flow and cause these areas to erode.

Conduit outlet protection areas of rip rap or gabions are most prone to collection of sediment. When clogged with sediment, these features no longer dissipate the water energy discharged from the pipe resulting in potential downstream erosion. Similarly low flow channels may collect sediment over time impeding the full and complete drainage of the basin creating ponding conditions. Ponding conditions are known to promote mosquito breeding.

Sediment that has accumulated and is inhibiting the function of a basin must be removed. Sediment can be flushed from the outlet protection with the use of a high pressure hose. The dredged or removed sediment must be transferred to a waste pile or area that is protected from stormwater run-on. Make sure the removed sediment is not left in the vicinity of the basin where stormwater could come into contact with it and transport it back to the basin or nearby receiving waters.

Erosion Repair & Soil Stabilization

It is necessary that a uniform vegetative cover be maintained to prevent soil loss, to maintain structural integrity, and to enhance the pollutant removal benefits of a stormwater management basin. Failure to maintain a uniform vegetative cover could result in structural failure and sediment loss.

Take corrective actions when erosion is found. Repair activities should be tailored to the specific site conditions, grass type, and seasonal variations. Repair may include the use of one or a combination of the following measures: erosion control blankets, riprap, matting, sodding, and/or seeding and mulching.

Animal Burrow Repair

Voids created by animal burrows can weaken dams and embankments, and result in structure failure. Animal burrows found in the dams, berms, and embankments of stormwater management basins should be filled in as soon as possible. Burrows should be completely filled in and properly compacted using an appropriate earthen material. Reestablish desirable vegetation to stabilize the area and prevent erosion. If burrowing problems persist, local wildlife officials should be consulted for information regarding preventive tactics or animal removal.

Glossary

Attenuate	The reduction of flow in volume and/or force
Berm	Elevated earthen embankment that impounds stormwater runoff within the stormwater management basin. Berms typically have a minimum top width of 10 feet.
Best Management Practice (BMP)	A general term most often used to describe methods that are the most effective and practical means of preventing or minimizing pollution. The term BMP is often used to describe the structures that are built to reduce stormwater pollution.
Channelization	The process by which concentrated flow erodes a channel through areas in or around a stormwater control that can lead to compromised performance of the control or even failure.
Concentrated Flow	Water that is flowing in a channel or pipe, or that has otherwise collected and is flowing in a manner not consistent with sheet flow.
Confined Space	A space that (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (for example, tanks, vessels, inlets, manholes, and pits); and (3) is not designed for continuous employee occupancy.
Embankment	An earthen berm, constructed from fill material, used to store runoff in basins.
Emergency Spillway	A level, depressed area along the top of berm over which stormwater is discharged during storm events exceeding the 100 year storm event or due to blockage of the primary outlet structure.
Detention Basin	A stormwater control that reduces peak stormwater flows, promotes the settling of suspended pollutants, and minimizes erosive velocities downstream of the outlet structure.
Erosion	The process by which a surface is worn away. In the context of this manual, erosion refers to the process by which runoff washes away soil.
Gabion	Wire mesh baskets filled with Rip-Rap stone installed to prevent erosion from higher velocity runoff conditions.
Impervious Surface	A land cover through which water cannot infiltrate; examples include concrete, asphalt, rooftops.

Infiltration	The act of water soaking through the surface of the soil.
Low Flow Channel	A relatively flat 3 to 6 inch deep channel constructed along the bottom of a detention basin typically constructed of concrete or bituminous asphalt. Used to provide positive drainage of runoff remaining after a storm event and prevent ponding of water.
Orifice	Positioned near the base of the outlet control structure, the drawdown orifice is a restricting device that allows stormwater to slowly enter the outlet box. In most cases, the drawdown orifice consists of either one or more 3-inch holes drilled directly into the side of the box or a predrilled steel plate attached to the side of the outlet control structure covering a manufactured outlet opening
Outlet Control Structure	Typically a concrete structure within the basin that incorporates weirs and orifices to regulate the discharge of stormwater through the stormwater management basin.
Outlet Protection	Rip rap or gabions installed at a storm sewer discharge location
Percolation	The act of water traveling downward through the soil.
Permanent Soil Reinforcement Matting	A material used to hold soil in place so that vegetation can take root and prevent erosion; commonly used in areas with steep slopes or other erosive conditions.
Rip-Rap	Large quarry processed rock that can vary in size from 3 inches to 24 inches installed at the discharge of a storm sewer pipe discharge or along a channel to prevent erosion
Runoff	Precipitation on land that eventually reaches streams and rivers.
Sediment	Soil that has been eroded and deposited elsewhere; typically contains pollutants and has a negative impact on aquatic environments.
Seepage	The slow discharge or escape of water.
Sheet Flow	A shallow layer of water flowing over land at a low velocity, enabling pollutants to settle out.
Storm Event	Rainfall events categorized by their frequency. For example a 10 year storm event has a likelihood of occurring once every 10 years or a 10 percent chance each year. Similarly a 100 year storm event has a likelihood of occurring once every 100 years or a 1 percent chance each year.

Stormwater	A term used to describe water that originates from precipitation; often used interchangeably with the term <i>runoff</i> .
Suspended Solids	Small particles carried in stormwater as a result of erosion; regarded as an indicator of water quality.
Swale	A vegetated channel that conveys stormwater runoff.
Toe (of embankment)	The bottom of the embankment where it meets the natural ground.
Trash Rack	A stainless steel or aluminum grid applied to the upstream portion of an outlet structure to prevent trash and debris from clogging the control devices.
Weir	A control feature of an outlet control structure which is a rectangular or triangular notch that regulates the flow of stormwater through the structure

Appendix “A”

Inspection and Maintenance Checklist

Extended Detention Basin Inspection and Maintenance Checklist

Property Address: _____

Property Owner: _____

Treatment Measure No.: _____

Date of Inspection: _____

Type of Inspection: Monthly Pre-Wet Season
 After heavy runoff (1" or greater)
 End of Wet Season
 Other: _____

Inspector(s): _____

Defect	Conditions When Maintenance Is Needed	Maintenance Needed? (Y/N)	Comments (Describe maintenance completed and if any needed maintenance was not conducted, note when it will be done.)	Results Expected When Maintenance Is Performed
General				
Trash & Debris	<ul style="list-style-type: none"> Trash and debris accumulated in basin. Visual evidence of dumping. 			Trash and debris cleared from site and disposed of properly.
Undesirable Vegetation	Weeds, invasive vegetation and woody plants			Vegetation treated with herbicides or physically removed and disposed of properly.
Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.			No contaminants or pollutants present.
Animal Burrows	If facility acts as a dam or berm, any evidence of rodent holes, or any evidence of water piping through dam or berm via rodent holes.			The design specifications are not compromised by holes. Any rodent control activities are in accordance with applicable laws and do not affect any protected species.
Insects	Insects such as wasps and hornets interfere with maintenance activities.			Insects do not interfere with maintenance activities.
Tree/Brush Growth and Hazard Trees	<ul style="list-style-type: none"> Growth does not allow maintenance access or interferes with maintenance activity. Dead, diseased, or dying trees. 			<ul style="list-style-type: none"> Trees do not hinder maintenance activities. Remove hazard trees. (Use a certified Arborist to determine health of tree or removal requirements).

Extended Detention Basin Inspection and Maintenance Checklist

Property Address: _____

Date of Inspection: _____

Treatment Measure No.: _____

Defect	Conditions When Maintenance Is Needed	Maintenance Needed? (Y/N)	Comments (Describe maintenance completed and if any needed maintenance was not conducted, note when it will be done.)	Results Expected When Maintenance Is Performed
Drainage time	Standing water remains in basin more than five days after a storm event.			Correct any circumstances that restrict the flow of water from the system. Restore drainage to design condition. If the problem cannot be corrected and problems with standing water recur, then mosquitoes should be controlled by a licensed pesticide applicator.
Outfall structure	Debris or silt build-up obstructs an outfall structure.			Remove debris and/or silt build-up and dispose of properly.
Side Slopes				
Erosion	<ul style="list-style-type: none"> Eroded where cause of damage is still present or where there is potential for continued erosion. Any erosion on a compacted berm embankment. 			Cause of erosion is managed appropriately. Side slopes or berm are restored to design specifications, as needed.
Storage Area				
Sediment	Accumulated sediment affecting inflow or outflow of the facility			Sediment cleaned out to designed basin shape and depth; basin reseeded if necessary to control erosion. Sediment disposed of properly.
Emergency Overflow/ Spillway and Berms				
Settlement	Berm settlement lower than the design elevation.			Dike is built back to the design elevation.
Tree Growth	Tree growth on berms or emergency spillway.			<ul style="list-style-type: none"> Trees should be removed. If root system is small the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed professional engineer should be consulted for proper berm/spillway restoration.
Emergency Overflow/ Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.			Rocks and pad depth are restored to design standards.

Debris Barriers (e.g., Trash Racks)				
Trash and Debris	Trash or debris is plugging openings in the barrier.			Trash or debris is removed and disposed of properly.
Damaged/ Missing Bars	Bars are missing, loose, bent out of shape, or deteriorating due to excessive rust.			Bars are repaired or replaced to allow proper functioning of trash rack.
Inlet/Outlet Pipe	Debris barrier is missing or not attached to pipe.			Debris barrier is repaired or replaced to allow proper functioning of trash rack. There are to be no barriers present at pipe discharges.
Fencing and Gates				
Missing or broken parts	Any defect in or damage to the fence or gate that permits easy entry to a facility.			Fencing and gate are restored to design specifications.
Deteriorating Paint or Protective Coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.			Paint or protective coating is sufficient to protect structural adequacy of fence or gate.
Miscellaneous				
Miscellaneous	Any condition not covered above that needs attention to restore extended detention basin to design conditions.			Meets the design specifications.

Appendix “B”

Detention Basin Retrofits and Maintenance

by

Rutgers Cooperative Extension Water Resource Program

<http://water.rutgers.edu/Projects/Sussex/Detention%20Basin%20Retrofits%20and%20Maintenance.pdf>

Sussex County Green Infrastructure Seminar Series
Seminar 2

Friday, October 29, 2010
1:00-3:00PM
Byram Township Municipal Building

Detention Basin Retrofits and Maintenance

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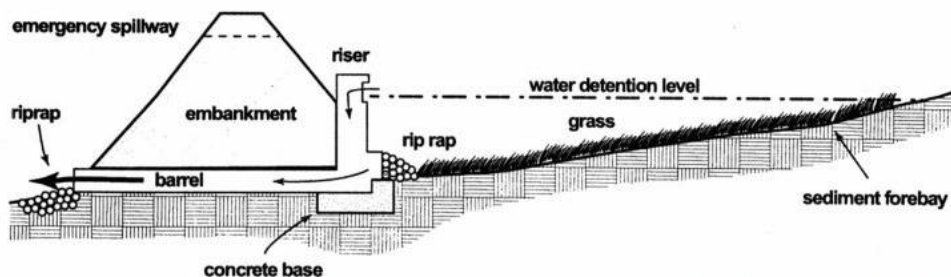
Presentation Overview

1. Overview of various basin designs
2. Common landscaping and maintenance concerns
3. Maintenance requirements
4. Typical maintenance costs
5. Ways to reduce maintenance
6. Case Studies
7. Planning for maintenance
8. NJ BMP Manual – Maintenance Plan
9. References

What is a Detention Basin?

Basins whose outlets have been designed to detain stormwater runoff for some minimum time to prevent downstream flooding. Provide quantity control, mowed regularly with concrete low-flow channels, dry except during and immediately following a storm event (typically 48 hours).

Basins can also treat stormwater runoff through settling of particles.



Detention Basin



Detention Basin

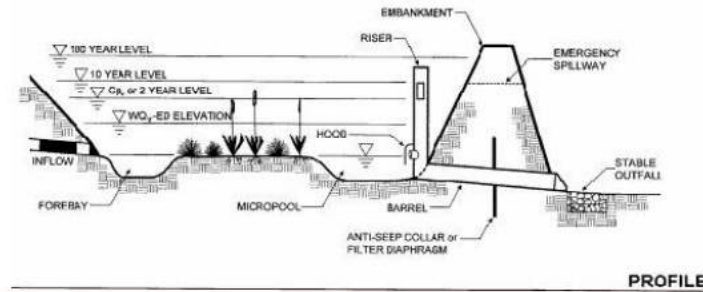


What is a Retention Basin?

(a.k.a. stormwater ponds, wet retention ponds, wet ponds)

Retention basins are often used as landscape amenities with permanent pools of standing water, stormwater fills the basin during rainfall events and discharges until permanent water surface elevation is reached.

Ponds will treat incoming stormwater runoff by allowing particles to settle and algae to take up nutrients.



PROFILE

Traditional Retention Basin



Traditional Retention Basin



Detention Basin vs. Retention Basin

Does the basin hold a permanent pool of water?

NO – Detention

YES – Retention



USEPA

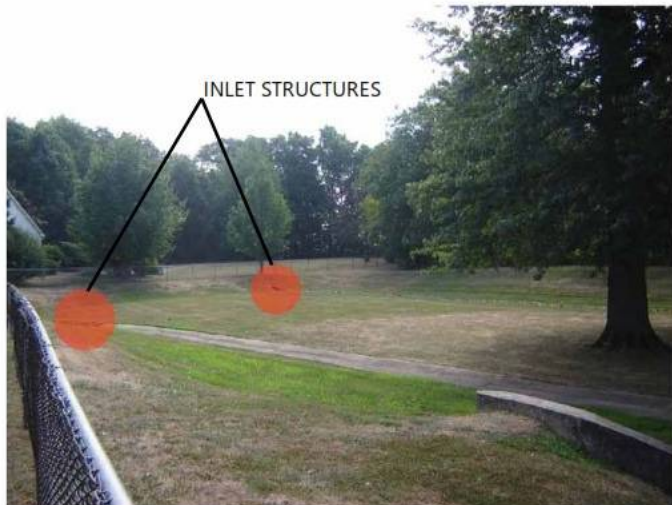


USEPA

Detention Basin Anatomy



Detention Basin Anatomy



Detention Basin Anatomy



Detention Basin Anatomy



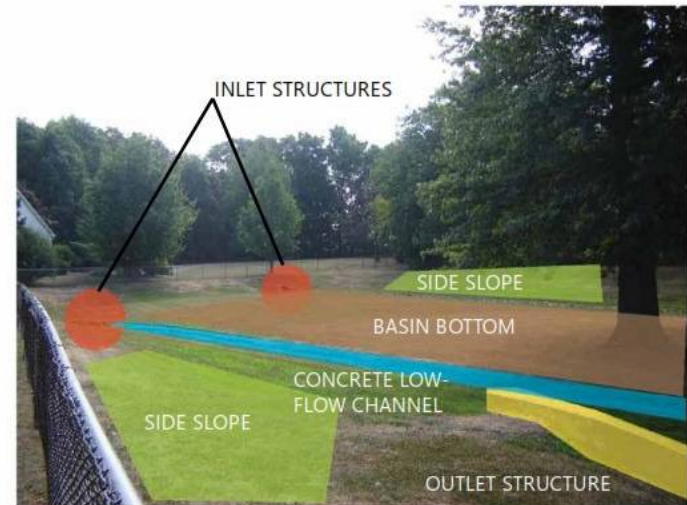
Detention Basin Anatomy



Detention Basin Anatomy



Detention Basin Anatomy



Common Concerns with Traditional Dry Detention Basins

1. Embankment and outlet stabilization
2. Sedimentation
3. Outlet blockages
4. Broken or clogged low-flow channels
5. Standing water or wet soils
6. Floatables and debris
7. Weeds or woody vegetation
8. Mowing and landscaping costs

Maintenance Considerations

Activity	Schedule
•Note erosion of pond banks or bottom	Semiannual inspection
•Inspect for damage to the embankment •Monitor for sediment accumulation in the facility and forebay •Examine to ensure that inlet and outlet devices are free of debris and operational	Annual inspection
•Repair undercut or eroded areas •Mow side slopes •Manage pesticide and nutrients •Remove litter and debris	Standard maintenance
•Seed or sod to restore dead or damaged ground cover	Annual maintenance (as needed)
•Remove sediment from the forebay	5- to 7-year maintenance
•Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25 percent	25- to 50-year maintenance

Maintenance Requirements

- Routine Maintenance
 - Vegetation management
 - Debris and litter removal
 - Mechanical components maintenance
 - Inspections
- Non-Routine Maintenance
 - Stabilization and erosion control repairs
 - Sediment removal
 - Outlet repair or replacement

Properly designed and maintained wet detention basins can remove 80% of the suspended solids in urban runoff.

Maintenance Requirements

Routine Maintenance

Routine Maintenance

- **Vegetation management**
 - Mowing should be done where/when it is needed (traditionally, 10-14 times per year)
 - Effective groundcovers must be kept healthy to prevent erosion and damage to the system
- **Debris and litter removal**
 - Inlets and outlets should be regularly cleared of debris and litter to prevent obstructions and reduced efficiency of the system
- **Mechanical components maintenance**
 - All mechanical equipment, such as gates, valves, locks, or other components must be kept in working order should an emergency arise
- **Inspections**
 - Regular inspections by designated personnel, owner, or operator should be made and clear records kept

Expected Costs for Annual Routine Maintenance



- Approximately 3-5% of construction cost for annual maintenance of dry detention basin or wet detention pond
- Mowing can cost between \$100-\$500 per visit
- Intensive maintenance including mowing, weed control, fertilization, etc. can range from \$500-\$3,500/acre annually

Other Cost Considerations

$$C = 12.4V^{0.760}$$

where:

C = Construction, design, and permitting cost, and

V = Volume needed to control the 10-year storm (ft³).

Using this equation, typical construction costs are:

\$ 41,600	1 acre-foot pond
\$ 239,000	10 acre-foot pond
\$ 1,380,000	100 acre-foot pond

Source: USEPA

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/>

Reducing Routine Maintenance

- **Vegetation management**
 - Reduce need for mowing
 - Eliminate any use of commercial fertilizers and pesticides in stormwater management facilities
- **Debris and litter removal**
 - Install simple low cost retrofits on catch basins near the discharge to the detention system
- **Mechanical components maintenance**
 - Regular inspections and immediate repairs will reduce need for major replacements
- **Inspections**
 - Clearly identify appropriate personnel and have same individual conduct inspections at regular intervals

Vegetation Management

Meadow Management

- Reduce mowing frequency of the basin bottom and embankments to a single monthly mowing at a height of 6-8 inches during the months of May through September



Meadow Management



Vegetation Management

No mow zones

- In wet pond systems, eliminating regular mowing of the shoreline edge for a minimum of 5-10 feet and allowing vegetation to grow to a height of 24 to 30 inches is recommended for several reasons:
 - Reducing mowing will promote deeper root growth and soil stability at the pond edge.
 - The vegetation will filter runoff from surrounding areas reducing nutrients and other pollutants in the pond,
 - The vegetation will deter use of the facility by unwanted Canada geese through the physical and visual barrier,

No Mow Zones



No Mow Zones



Vegetation Management

Naturalized Plantings

- Install native plantings adapted to flood plain and wetland conditions and eliminate regular mowing.
- Requires upfront funds to design, purchase materials and install vegetation.
- Often these costs can be offset through the use of local volunteers or nonprofit environmental organizations.
- This approach requires careful planning and a commitment to maintain new plantings during the establishment period.
- These plantings can often be done in conjunction with basin repairs and/or retrofits.
- This approach is the “preferred” design option in the new BMP manual as it improves the effectiveness of the stormwater facility to treat water quality as well as water quantity.

Naturalized Plantings



Naturalized Plantings

- Seed in the spring or fall at a minimum rate of 10-15 lbs/acre
- Can be applied via broadcasting, hydroseeding, or with a native 'TRUAX' seed drill
- Need to be mulched during establishment with weed free straw or wood fiber mulch
- Can be applied to bare soil, over-seeded, or to sites treated with glyphosate herbicide
- Seed mix should contain warm-season companion grasses in combination with wildflowers
- Require a single annual mowing at a height of no less than 6 inches



Cherry Hill Township saved \$20,000 per year on mowing costs by naturalizing detention basins.

Naturalized Plantings

Common Wildflowers		Aquatic Vegetation for Wet Ponds	
Botanical Name	Common Name	Botanical Name	Common Name
<i>Asclepias incarnata</i>	Swamp Milkweed	<i>Pontederia cordata</i>	pickerelweed
<i>Aster novae-angliae</i>	New England Aster	<i>Sagittaria latifolia</i>	duck-potato
<i>Aster novi-belgii</i>	New York Aster	<i>Saururus cernuus</i>	lizard tail
<i>Eupatorium perfoliatum</i>	Boneset	<i>Scirpus atrovirens</i>	green bulrush
<i>Iris pseudacorus</i>	Yellow-Flag	<i>Spartanium americanum</i>	lesser bur-reed
<i>Iris versicolor</i>	Blue-Flag		
<i>Lobelia cardinalis</i>	Cardinal Flower	Warm Season Grasses	
<i>Lobelia siphilitica</i>	Great Lobelia	Botanical Name	Common Name
<i>Yernonia noveboracensis</i>	New York Ironweed	<i>Agrostis alba</i>	Red Top
		<i>Agrostis palustris</i>	Creeping Bentgrass
		<i>Andropogon scoparius</i>	Little Bluestem
		<i>Andropogon virginicus</i>	Broomsedge
		<i>Calamagrostis canadensis</i>	Canada Wild Rye
		<i>Elymus canadensis</i>	Canada Wild Rye
		<i>Poa palustris</i>	Fowl Bluegrass
		<i>Puccinellia distans</i>	Alkaligrass
		<i>Tripsacum dactyloides</i>	Eastern Gamagrass

Common Wetland Plants

Botanical Name	Common Name
<i>Carex stricta</i>	tussock sedge
<i>Carex vulpinoidea</i>	fox sedge
<i>Carex crinita</i>	fringed sedge
<i>Juncus effusus</i>	Soft Rush

NOTE:

Native wildflower and grass seed mixes available from Ernst Conservation Seeds in Meadville, PA

Native plant material available from Pinelands Nursery in Columbus, NJ

Naturalized Plantings

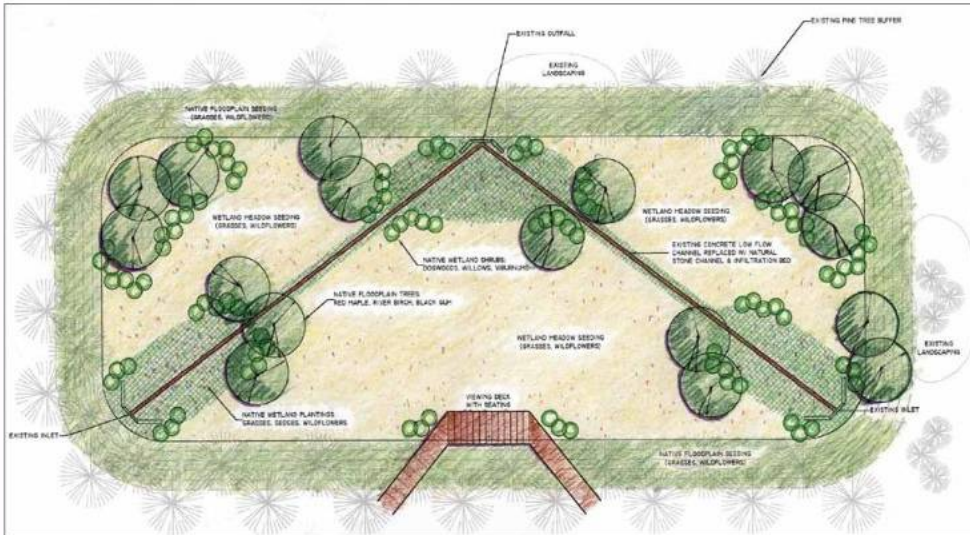


Egg Harbor Township
New Jersey



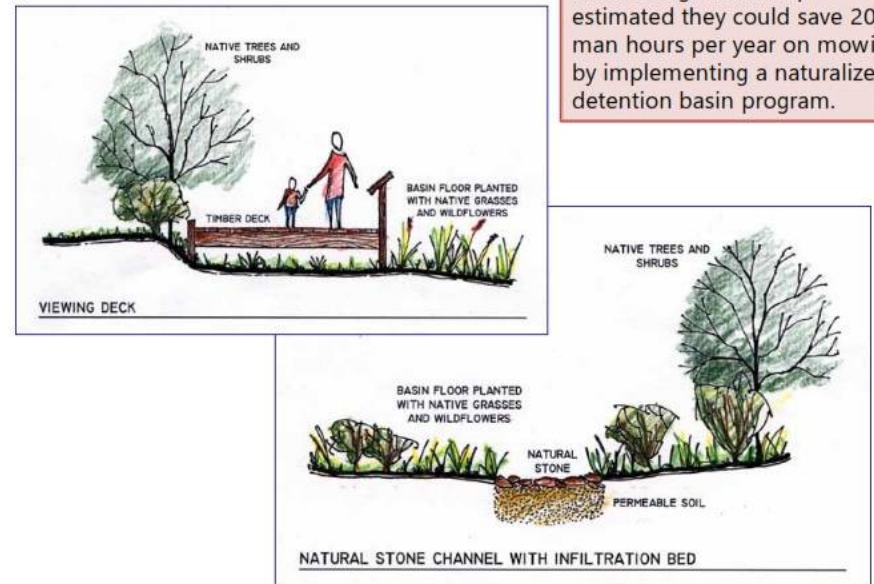
Naturalized Plantings

Naturalized Detention Plan



Naturalized Plantings

Vegetated Basin



Naturalized Plantings & Mosquitoes

- Mosquitoes can breed in almost any wet area containing standing water, including:
 - Containers/old tires
 - Catch basins
 - Gutters
 - Low wet spots in lawns
- Healthy naturalized systems provide habitat to many mosquito predators, including:
 - Dragonflies
 - Damselflies
 - Water Striders
 - Backswimmers
 - Predacious Diving Beetles
- Always provide and maintain access for inspection and treatment



www.richard-seaman.com

Mechanical Components Maintenance

- Regular inspections and immediate repairs will reduce need for major replacements



Regular Inspections

At a minimum, regular inspections should:

- Document any erosion or sedimentation and identify any needs for repair or replacement
- Provide review of the inlet and outlet structures and note any deterioration, evidence of malfunctions, or collection of debris
- Document condition of the vegetation, noting any evidence of poor health, establishment of exotic species or weeds, woody growth on embankments, or need for any replacement
- Note any standing water or evidence of extended ponding not intended in the design or function of the system
- Note whether clear access to the facility is being maintained as per the design plans
- Document current and recent weather conditions and include a digital photograph of the facility

Maintenance Requirements

Non-Routine Maintenance

Non-Routine Maintenance

- Stabilization and erosion control repairs
 - If vegetation fails on embankments or in the basin, soil replacement, reseeding and stabilization should occur immediately
- Sediment removal
 - During the establishment of a new basin, the basin should be inspected for excessive sedimentation. After establishment, the basin should be inspected twice a year and excessive sediment accumulated in the basin should be removed.
- Outlet repair or replacement
 - Should the system stop functioning as designed the outlet structure may require repair or replacement

Expected Costs for Non-Routine Maintenance

- Sediment removal estimated to be needed:
 - Every 5-15 years for wet pond
 - Every 2-10 years for a dry pond
- Expected costs for sediment removal:
 - Mobilization \$2,500 - \$5,000 (dependent on size of project)
 - Dredging work \$10/cy - \$20/cy (dependent on depth of sediment)
 - Disposal off-site \$45/cy - \$75/cy (extremely variable and dependent on hauling distance, quality of material, and disposal requirements)
- Expected costs for pre-cast concrete replacement outlet structure:
 - \$5,000 - \$15,000 depending on size of structure, access, and complexity of the installation

Reducing Costs for Non-Routine Maintenance

- Stabilization and erosion control repairs
 - Ensure basin designs do not incorporate steep embankments (greater than 3:1)
 - Maintain healthy groundcovers by not mowing basin areas to less than 4" inches in height
- Sediment removal
 - Install manufactured pre-treatment device prior to stormwater discharging to basins
 - Install a settling forebay near inlets where access can be provided and reached with available excavation equipment
 - Retrofit system for water-quality treatment
- Outlet repair or replacement
 - Conduct regular inspections to ensure system is functioning properly and debris and litter are not clogging the outlet
 - Provide and maintain clear access to all structures of the system

Stabilization and Erosion Control Repairs

- Ensure basin designs do not incorporate steep embankments (greater than 3:1)
- Maintain healthy groundcovers by not mowing basin areas to less than 4" inches in height



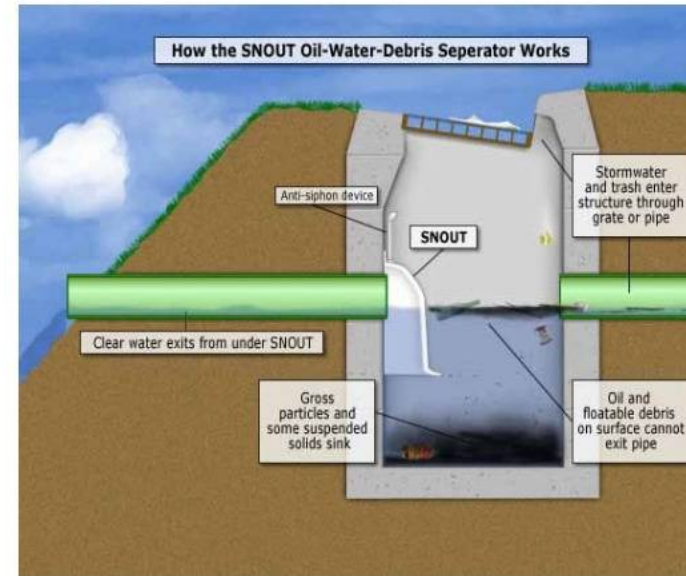
Sediment Removal

Manufactured Pre-Treatment Systems

- Intended to capture sediments, metals, hydrocarbons, floatables, and/or other pollutants in stormwater runoff before being conveyed to a storm sewer system, additional stormwater quality treatment facility, or waterbody.
- Adequate for small drainage areas that contain a predominance of impervious cover that is likely to contribute high hydrocarbon and sediment loadings, such as small parking lots and gas stations. For larger sites, multiple devices may be necessary.
- Devices are normally used for pre-treatment of runoff before discharging to other, more effective stormwater quality treatment facilities.

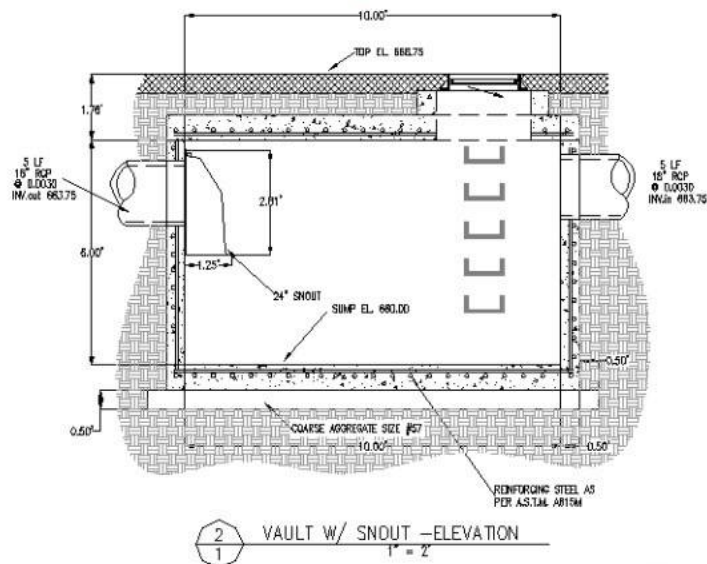
Debris and Litter Removal

Low Cost "Snout" Debris Separator

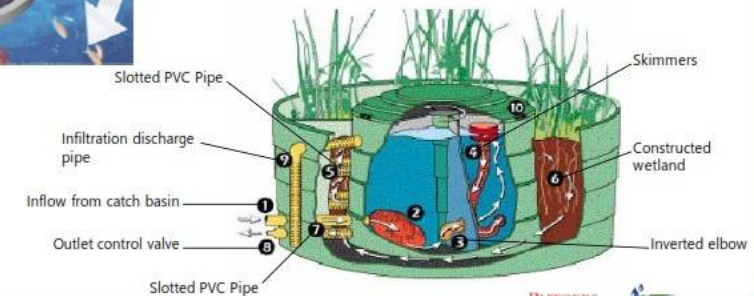
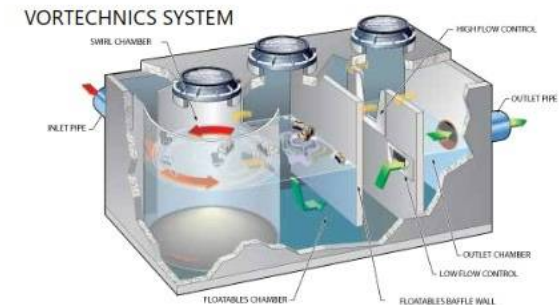


Debris and Litter Removal

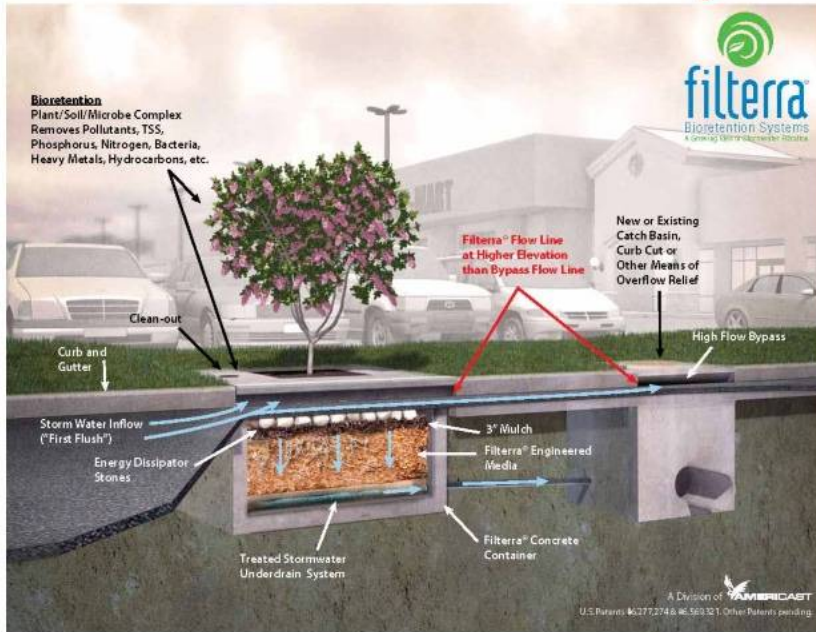
Low Cost "Snout" Debris Separator



Manufactured Pre-Treatment Systems



Manufactured Pre-Treatment Systems

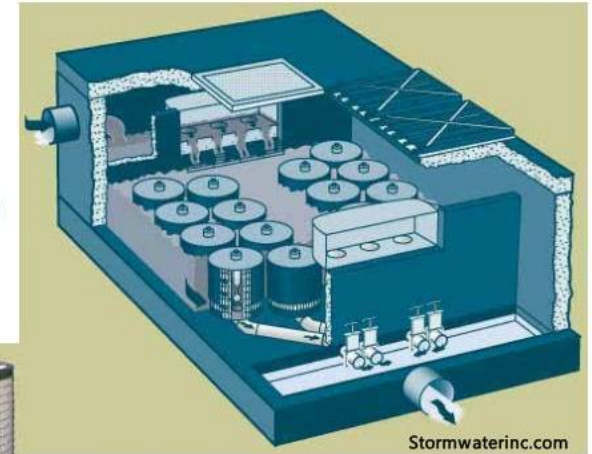


Manufactured Pre-Treatment Systems

The StormFilter System

- Major Components**
- Precast Vault
 - Filter Cartridges

- Considerations**
- Sizing
 - Optional Filter Media
 - 2.5' of Head needed
 - Maintenance



NOTE: Has received preliminary approval from NJ Office of Innovative Technology & Market Development

Manufactured Pre-Treatment Systems

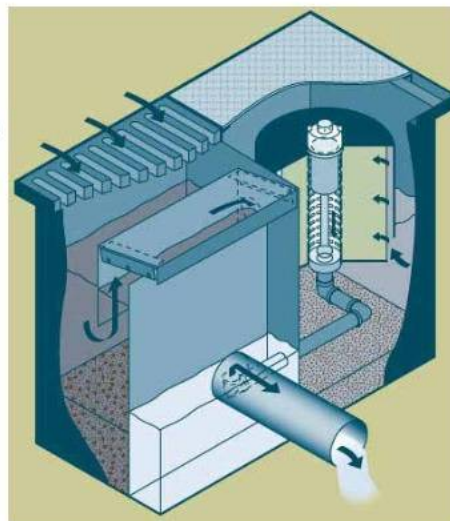
The Catchbasin StormFilter System

System Features and Benefits

- Targets site-specific pollutants
- Low cost, heavy gauge, all steel construction (Concrete units also available)
- Internal bypass that minimizes re-suspension of trapped pollutants

General Specifications

- StormFilter capacity - 15 gpm/cartridge (up to 4 cartridges)
- Peak hydraulic capacities:
Standard Steel Units -- 1.0 cfs
Deep Steel Units - 3.0 cfs
Concrete Units - 2.0 cfs
- Hydraulic drop (Rim to Invert): -
Standard Steel Unit - 2.3'
Deep Steel Unit - 3.3'
Concrete Unit - 2.75' to 2.9' "
- Outlet pipe diameter - up to 12"
- Load-bearing capacities:
Concrete Units - H-20
Steel Units - H-20 with concrete collar



Outlet Repair or Replacement

- Conduct regular inspections to ensure system is functioning properly and debris and litter are not clogging the outlet
- Provide and maintain clear access to all structures of the system



RETROFIT

1. Extended Detention Basin
2. Outlet
3. Water Quality



Retrofit: Extended Detention Basin

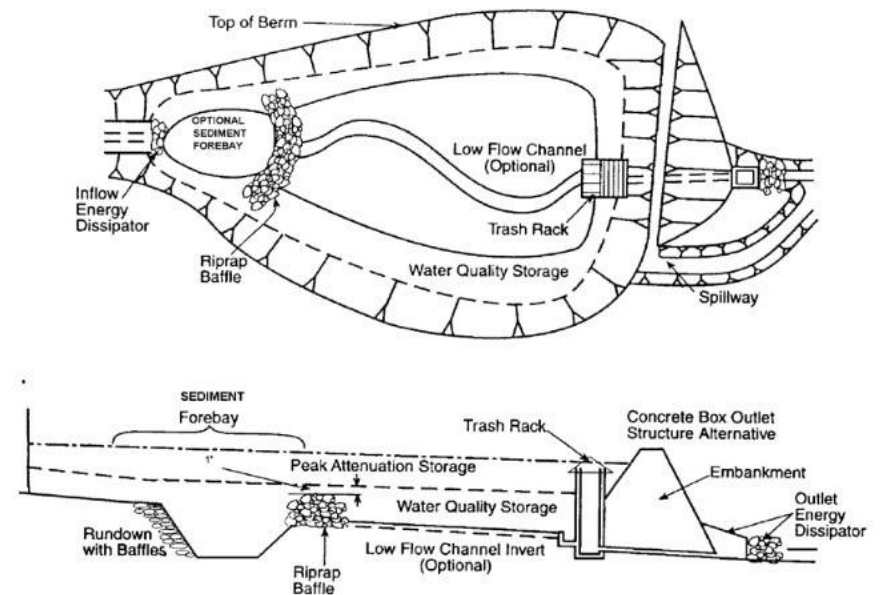
- Extended detention can address both the stormwater runoff quantity and quality impacts of land development.
- The lower stages of an extended detention basin can detain runoff from the Stormwater Quality Storm for extended periods of time, thereby promoting pollutant removal through sedimentation.
- Higher stages in the basin can also attenuate the peak rates of runoff from larger storms for flood and erosion control.
- Extended detention basins are designed for complete evacuation of runoff and normally remain dry between storm events.
- To enhance soluble pollutant removal, the lower stages of an extended detention basin may also be designed with a permanent pool and partially function as either a wetland or retention basin.

Keys for Extended Detention Basin

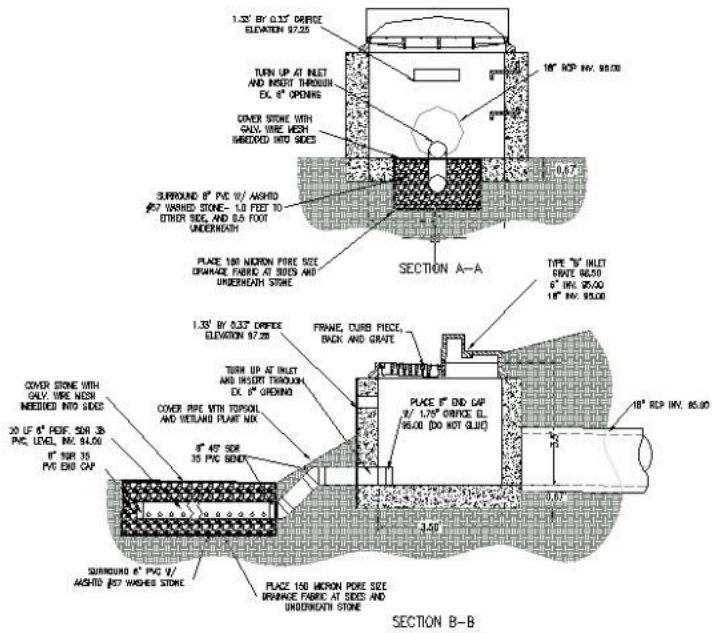
- The basic design parameters for an extended detention basin are its *storage volume* and *detention time*.
- An extended detention basin must have the correct combination of storage volume and outflow capacity to contain and *slowly* discharge the design runoff volume over a prescribed period of time.



Extended Detention Basin Concept



Retrofit: Outlet Modification



Retrofit: Outlet Modification



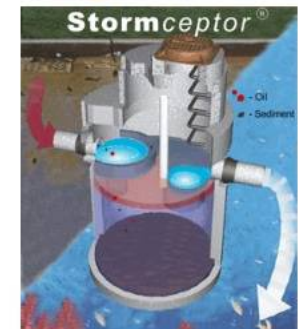
Retrofit: Outlet Modification



8.17.2003

Retrofit: Water Quality

- Basins
 - Vegetate with Native Species
 - Remove Concrete Low Flow Channels
 - Install Permeable Weirs
- Storm Inlet Filtering Devices
- Manufactured Treatment Devices
- Disconnect Impervious Surfaces



Capturing, treating and infiltrating the runoff generated by the water quality storm.

Expected Costs for Naturalized Plantings and Retrofits

- Native seeding or plantings
 - Native seed costs: \$25/lb - \$45/lb
 - Installation costs: range from \$80 - \$150 per 1000 sq ft
 - Native wetland plants costs: \$200 - \$250 per 1000 sq ft installed
- "Snout" installation - \$500
- Pre-manufactured treatment device installation
 - \$10,000 - \$60,000 depending on size and complexity of the installation
- Settling forebay or permeable weir Installation
 - \$2,500 - \$5,000 for filter fabric, rip-rap stone, and installation, depending on size and access
- Pre-cast concrete retrofit outlet structure:
 - \$5,000 - \$10,000 installed depending on size of structure, access, and complexity of the installation

Case Studies

Case Studies

Teaberry Run
Moorestown, NJ

EXISTING CONDITIONS



Case Studies

Teaberry Run
Moorestown, NJ

AFTER INSTALLATION



Case Studies

Teaberry Run
Moorestown, NJ

1 YEAR LATER



Case Studies

Baker Elementary School
Moorestown, NJ

EXISTING CONDITIONS



Case Studies

Baker Elementary School
Moorestown, NJ

PLANTING



Case Studies

Baker Elementary School
Moorestown, NJ

1 YEAR LATER



Case Studies

Mercer County SCD Wildflower Detention Basin Planting Program
New Jersey

- Reduce need for watering
- Eliminate use of chemical fertilizers and pesticides
- Minimize mowing
- Provide visual contrast in the landscape and provide habitat



Case Studies

Roadside Drainage Retrofit Program
Hunterdon County, NJ



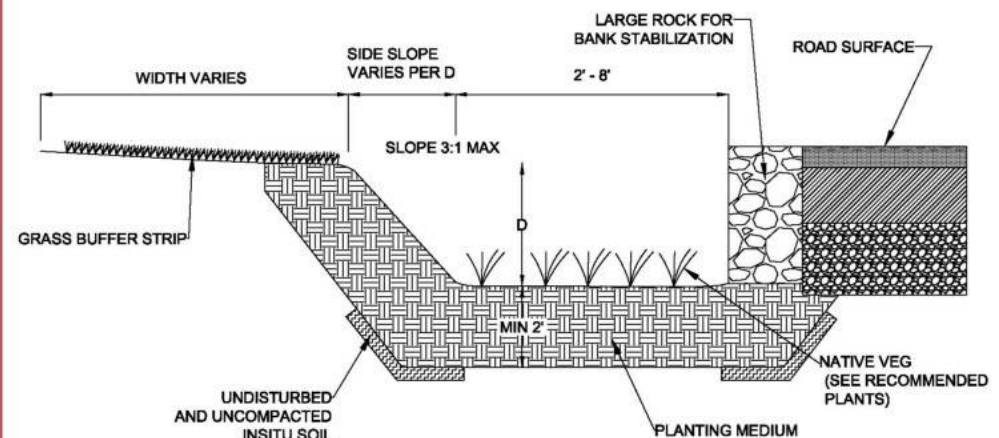
Case Studies

Roadside Drainage Retrofit Program
Hunterdon County, NJ

- Develop cost-effective designs strategies to address the roadside drainage issues associated with these watersheds
- Develop cost-effective routine maintenance practices to reduce sediment loads
- Build capacity within the local municipalities to implement the design and maintenance strategies in a cost-effective manner

Case Studies

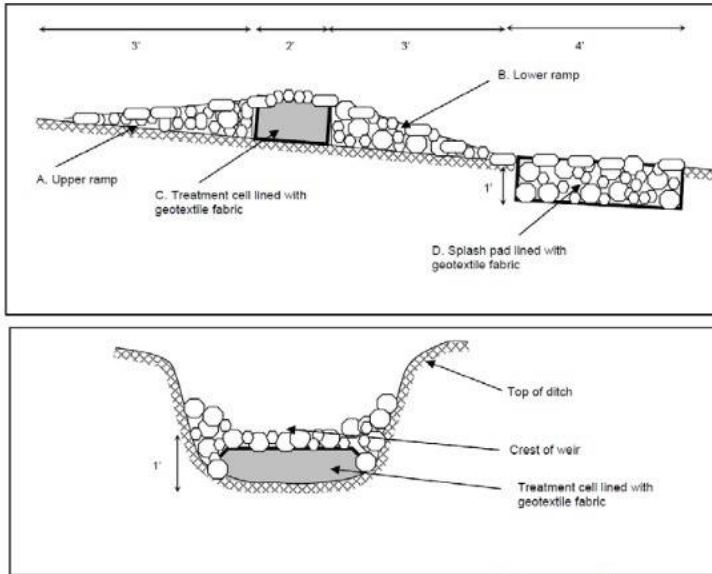
Roadside Drainage Retrofit Program
Hunterdon County, NJ



Case Studies

Roadside Drainage Retrofit Program
Hunterdon County, NJ

Modified Check Dam Designs

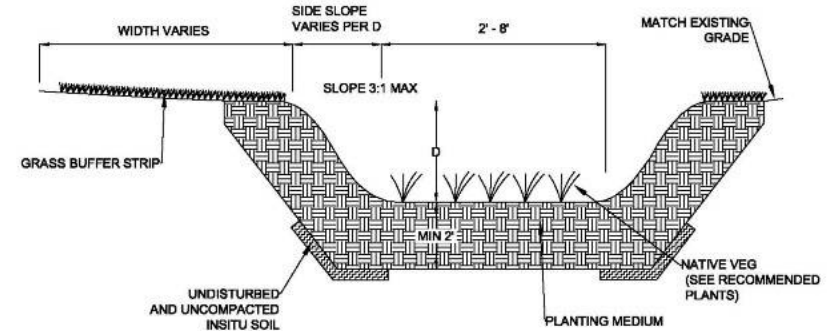


Courtesy of Washington State, King County DOT

Case Studies

Roadside Drainage Retrofit Program
Hunterdon County, NJ

Rebuild existing swale to be wider and deeper within the right of way and the given space on North Side. Vegetate with native grasses and plants. On South Side, rebuild section of swale and install a check dam. Swale to follow NJ Standards for Soil Erosion and Sediment Control and guidance from NJDEP BMP Manual.



Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

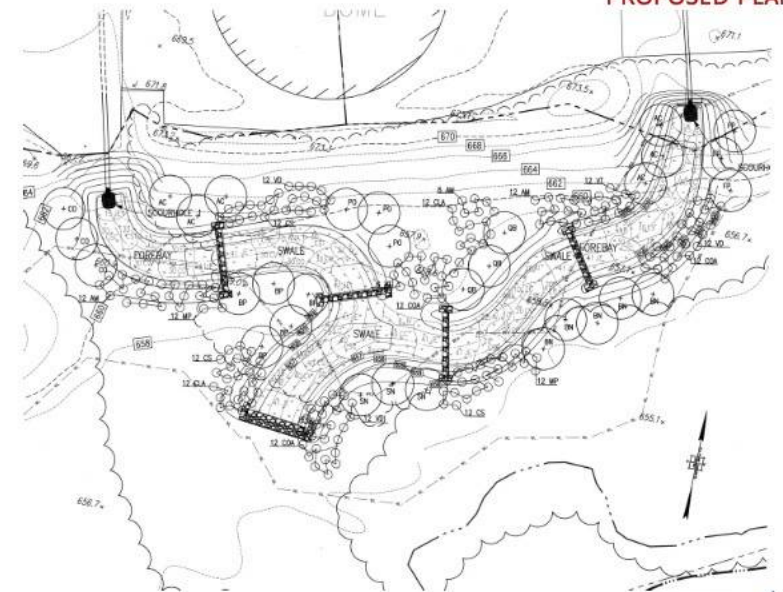
EXISTING CONDITIONS



Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

PROPOSED PLAN



Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

CONSTRUCTION



Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

CONSTRUCTION



Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

COMPLETED PROJECT



Case Studies

Hillsborough Detention Basin Retrofit Program
Somerset County, NJ



VALIS ROAD



WESCOTT ROAD



PRALL ROAD



FRANCIS ROAD



UPDIKE ROAD

TABLE OF CONTENTS

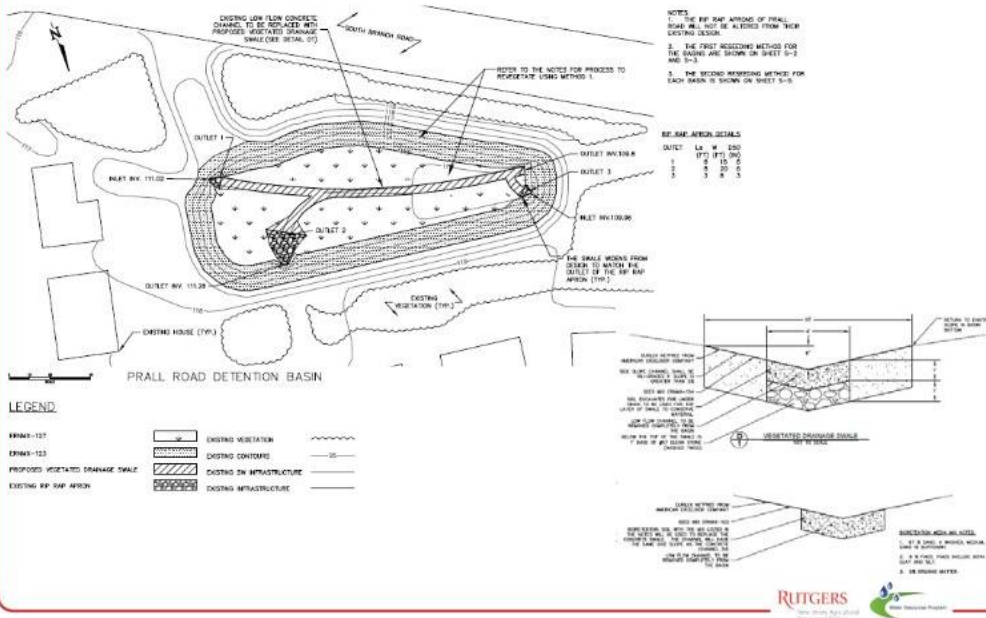
SHEET C-1:	COVER SHEET
SHEET S-1:	VALIS AND PRALL ROAD
SHEET S-2:	FRANCIS AND UPDIKE STREET
SHEET S-3:	WESCOTT ROAD
SHEET S-4:	VALIS AND PRALL ROAD (ALTERNATIVE LANDSCAPING PLAN)
SHEET S-5:	FRANCIS AND UPDIKE STREET (ALTERNATIVE LANDSCAPING PLAN)
SHEET S-6:	WESCOTT ROAD (ALTERNATIVE LANDSCAPING PLAN)

APRIL 30, 2009

Case Studies

Hillsborough Detention Basin Retrofit Program
Somerset County, NJ

Prall Road



Case Studies

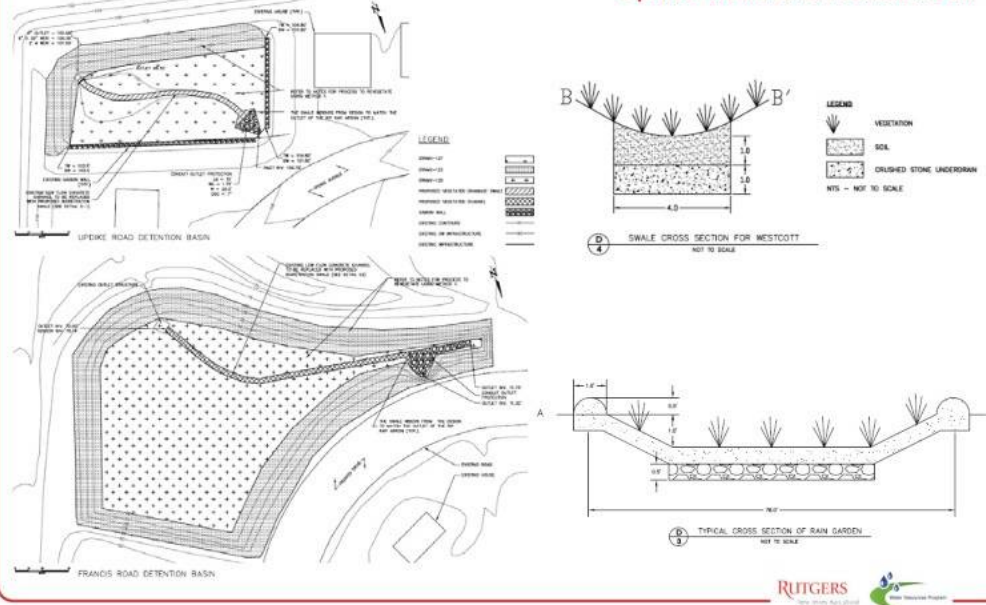
Prall Road Detention Basin Retrofit
Township of Hillsborough, NJ



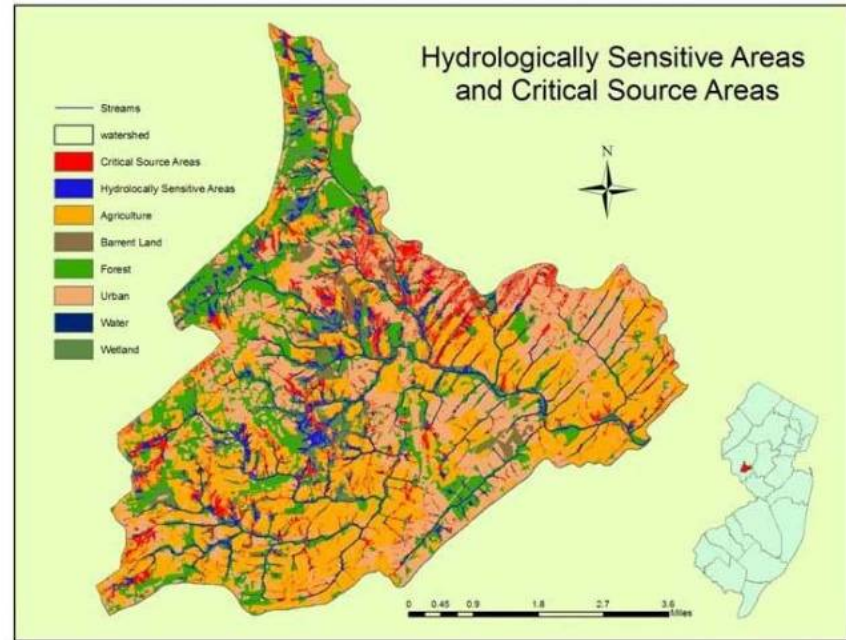
Case Studies

Hillsborough Detention Basin Retrofit Program
Somerset County, NJ

Udpike Road and Francis Road



Case Studies – Neshanic River Watershed



Case Studies

Neshanic River Watershed
Hunterdon County, NJ



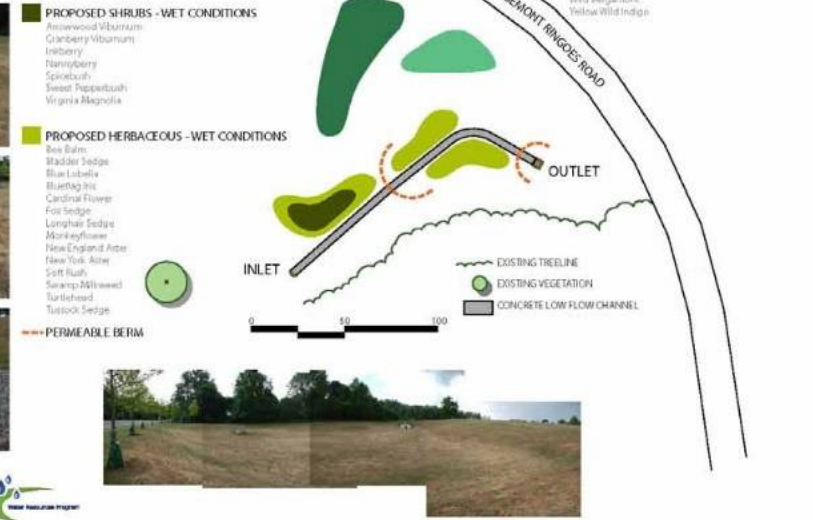
RUTGERS
New Jersey Agricultural
Experiment Station



NESHANIC RIVER WATERSHED
MBD-0035



RUTGERS
New Jersey Agricultural
Experiment Station



NESHANIC RIVER WATERSHED
MBD-0054



RUTGERS
New Jersey Agricultural
Experiment Station



NESHANIC RIVER WATERSHED
MBD-0136



RUTGERS
New Jersey Agricultural
Experiment Station





NESHANIC RIVER WATERSHED

MBD-0069

PROPOSED SHRUBS - WET CONDITIONS

Arrowwood Viburnum
Cranberry Viburnum
Hickory
Hairyberry
Spicebush
Sweet Pepperbush
Virginia Magnolia

PROPOSED HERBACEOUS - WET CONDITIONS

Ice Plant
Rabbit Sedge
Blue Lobelia
Blueflag Iris
Cardinal Flower
Fox Sedge
Longhair Sedge
Monkeyflower
New England Aster
New York Aster
Soft Rush
Swamp Milkweed
Turkhead
Tussock Sedge

PROPOSED SHRUBS - DRY CONDITIONS

Bayberry
Blackhaw Viburnum
Magnolia
Witchhazel

PROPOSED HERBACEOUS - DRY CONDITIONS

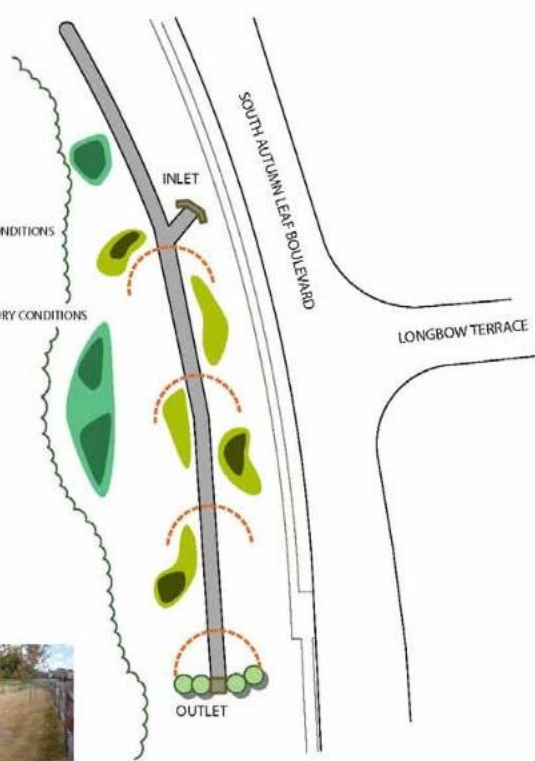
Bayberry
Big Bluestem
Black-eyed Susan
Blue Bluetower
Butterfly Milkweed
False Sunflower
Grey Goldenrod
New England Aster
Purple Coneflower
Switchgrass
Wild Dogwood
Yellow Wild Indigo

PERMEABLE BERM

EXISTING TREELINE

EXISTING VEGETATION

CONCRETE LOW FLOW CHANNEL



NESHANIC RIVER WATERSHED

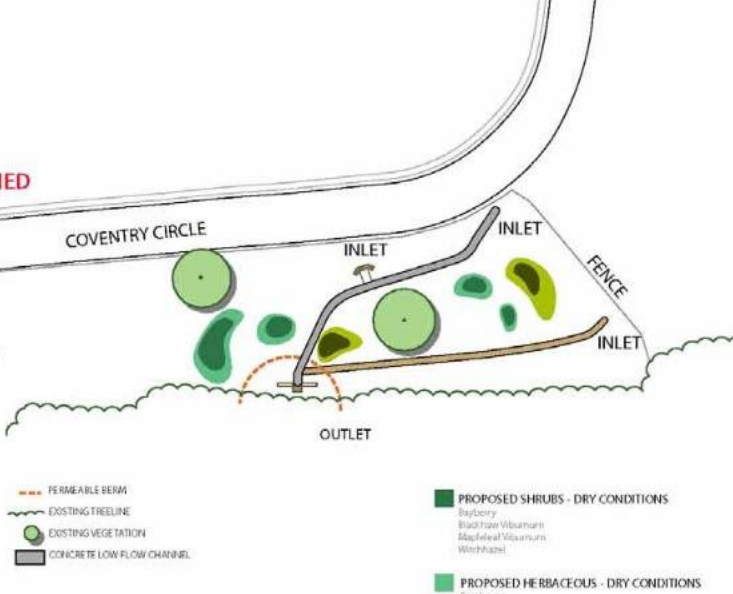
MBD-0150

PROPOSED SHRUBS - WET CONDITIONS

Arrowwood Viburnum
Cranberry Viburnum
Hickory
Hairyberry
Spicebush
Sweet Pepperbush
Virginia Magnolia

PROPOSED HERBACEOUS - WET CONDITIONS

Bee Palm
Rabbit Sedge
Blue Lobelia
Blueflag Iris
Cardinal Flower
Fox Sedge
Longhair Sedge
Monkeyflower
New England Aster
New York Aster
Soft Rush
Swamp Milkweed
Turkhead
Tussock Sedge



PERMEABLE BERM

EXISTING TREELINE

EXISTING VEGETATION

CONCRETE LOW FLOW CHANNEL



PROPOSED SHRUBS - DRY CONDITIONS

Bayberry
Blackhaw Viburnum
Magnolia
Witchhazel

PROPOSED HERBACEOUS - DRY CONDITIONS

Bayberry
Big Bluestem
Black-eyed Susan
Blue Bluetower
Butterfly Milkweed
False Sunflower
Grey Goldenrod
New England Aster
Purple Coneflower
Switchgrass
Wild Dogwood
Yellow Wild Indigo

Conclusions and Recommendations

Opportunities

Sussex County
New Jersey



Opportunities

Sussex County
New Jersey



Opportunities

Sussex County
New Jersey



Planning for Maintenance

- Identify individual/s or organization/s responsible for inspections and maintenance:
 - Public Entity
 - Homeowner's Association
 - Property Owner
- Provide a clear procedure for recording inspections and reporting maintenance needs
- Develop a routine maintenance schedule
- Develop and use a standard inspection form
- Clearly mark access areas for inspections and maintenance
- Identify and provide any specialized equipment or tools needed to properly maintain the facility
- Develop an emergency protocol should the system fail or not function as designed

NJ BMP Maintenance Manual Requirements

1. Identify person/s responsible for preventive and corrective maintenance
2. Identify specific preventive and corrective maintenance tasks and detailed information on specific structural components or nonstructural measures
3. Provide a schedule of regular inspections and tasks
4. Provide cost estimates of maintenance tasks
5. Include detailed logs of all preventive and corrective maintenance performed
6. Identify specialized tools or equipment needed
7. Recommend corrective responses if emergency arises
8. Provide guidance for safety during inspections and maintenance
9. Identify approved disposal and recycling sites and procedures for sediment, trash and debris
10. Include an as-built construction plan

Summary & Conclusion

1. With proper design and up front planning, routine maintenance of stormwater facilities can be accomplished without putting undue burden on operations personnel and budgets.
2. Non-routine maintenance requirements need to be accounted for and with regular inspections, these activities can be planned for and expected costs incorporated into operations budgets avoiding large unexpected capital expenditures.
3. Many options exist to modify existing systems to either reduce need for regular maintenance and/or improve the effectiveness of the system for both water quantity and water quality controls.



References

We recommend: *New Jersey Stormwater Best Management Practices Manual*
Available at: <http://www.state.nj.us/dep/watershedmgmt/bmpmanualfeb2004.htm>

Design References:

1. Maintaining Your BMP, A Guidebook for Private Owners and Operators in Northern Virginia, Northern Virginia Planning District Commission, Division of Environmental Services, February 2000.
2. Sustainable Sites and Natural Landscapes, Northeastern Illinois Planning Commission, January 2004.
3. Stormwater Management Basins and Their Maintenance, Monmouth County Mosquito Extermination Commission, 1999.
4. Minnesota Urban Small Sites BMP Manual, Metropolitan Council/Barr Engineering Co.
5. Maintaining Wet Detention Ponds, Land-of-Sky Regional Council, Asheville, NC.
6. Storm Water Technology Fact Sheet, Wet Detention Ponds, USEPA, 1999.
7. Establishing Wildflowers Tip-Sheet, Mercer County Soil Conservation District, 1995.
8. Indiana Wetland Conservation Plan Fact Sheet, Did You Know?...Healthy Wetlands Devour Mosquitoes, Indiana Department of Natural Resources.
9. The Maintenance of Residential Stormwater Management Areas, USDA NRCS, January 2000.
10. Operation, Maintenance, and Management of Stormwater Management Systems, Watershed Institute, Inc. and USEPA, August 1997.



Upcoming Seminars...

Green Infrastructure: Projects & Programs for Green Teams & Environmental Commissions

Monday, November 8, 2010

6:30-8:30PM

Sussex County Administrative Center

Green Infrastructure Planning, Design & Implementation: Training for Design Professionals

Tuesday, November 30, 2010

1:00-3:00PM

Sussex County Administrative Center

Visit www.water.rutgers.edu to register for each seminar.



QUESTIONS?

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